REMARKS:

Claims 1-19 are in the case and presented for consideration.

New claims 17-19 have been added. Support for new claim 17 can be found, for example, in Fig. 3. Support for new claims 18 and 19 can be found, for example, in paragraph [0040] of the specification. Accordingly, no new matter has been added.

Appreciation is expressed to the examiner for the review and discussion of Applicants' proposals for advancing the examination of this application during the telephone interviews held on June 14 and June 19, 2007. During the June 19, 2007 interview, the examiner suggested that certain claims might receive favorable consideration if they recite at least two discharge axes on each side of the deposition configuration. New claim 17 recites this feature and favorable consideration of claim 17 is respectfully requested.

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

First Rejection Under 35 U.S.C. § 103

Claims 1-8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,017,396 to Okamoto in view of U.S. Patent 5,753,045 to Karner et al. ("Karner"). The reasons for the rejection are stated on pages 2-3 of the Office Action. The rejection is respectfully traversed.

The Office Action states:

> Okamoto teaches a vacuum processing apparatus that includes: two plasma discharge configurations 11, 12 that form two plasma beams 16 having discharge axis parallel to each other and in a low-voltage high-current plasma beam gap between a cathode 11 and an anode 12; a deposition configuration 14 holding two substrates 15, ... which

> extend a selected distance from the beam axis along a substantially section of the discharge beam longitudinal direction and disposed between the discharge axis; a power supply 7 to independently drive each gap; a gas suction configuration (not shown); and a gas supply section 17, 18 for supplying a silicon containing gas parallel to the discharge axis. (Figure 4 and 6)

The Office acknowledges that Okamoto does not teach "the discharge axis A is substantially longer than any diameter of said discharge generation areas, or that the cathode is a hot cathode." The Office Action relies on Karner to provide the missing feature of Okamoto, namely, "a hot cathode plasma beam discharge configuration that has a discharge axis A that is substantially longer than any diameter of said discharge generation area. (Entire document, specifically, figures 1, 3, and 3a)." The Office Action then states the following as the motivation for the proposed modification: "to provide an alternate and equivalent plasma discharge configuration, and enable the apparatus to deposit metastable layers as taught by Karner, et al."

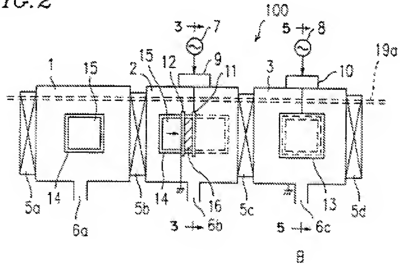
The Manual of Patent Examining Procedure (MPEP) at § 2143.01(V) states that "[i]f proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." Also, "[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." See MPEP at § 2143.01(VI). Moreover, it is "improper to combine references where the references teach away from their combination." See MPEP at § 2145(X)(D)(1).

For the reasons discussed in detail below, Applicants respectfully submit that the Okamoto and Karner references teach away from the proposed modification/combination. The Office's proposed modification also renders

inoperative and/or changes the principle of operation of the processing apparatus described in Okamoto.

According to Okamoto, "the substrate 15 is not exposed to the oxygen plasma 16, which is generated in a space between the electrodes 11 and 12 as seen from Fig. 4". This is to prevent the substrate from being damaged by the oxygen plasma. See Okamoto at col. 5, lines 55-59. Okamoto at col. 5, lines 65-67 also states, "the plasma 16 is generated in a relatively small region in the first vacuum chamber 2, as compared with the entire area of the substrate 15 (Fig. 2)." Also see Okamoto at col. 6, lines 10-18, which reiterated that the plasma is created in a "relatively small region interposed between the electrodes 11 and 12 in the first vacuum chamber, so that the plasma 16 does not reach the vicinity of the substrate 15." Therefore, Okamoto expressly requires the length of the discharge axis extending between electrodes 11 and 12 (i.e., the distance L between the electrodes 11 and 12) to be substantially shorter than the width of the plasma 16. See Fig. 2 of Okamoto (reproduced below).

FIG. 2



In addition, the film region, which corresponds to the cross sectional area of

the plasma, is relatively small and does not cover the entire surface of the substrate but extends across only one dimension (e.g., width) of the substrate. See Okamoto, col. 6, lines 61-64 and col. 7, lines 1-3.

The Office asserts that Karner (esp. Figs. 1, 3 and 3a) teaches a "discharge configuration that has a <u>discharge axis A that is substantially longer than any diameter of said discharge configuration area</u>". See Office Action at page 3, second paragraph. This is contrary to the specific teaching of Okamoto which requires the distance L between the electrodes 11 and 12 to be relatively small when compared with the width of the plasma (see, e.g., Okamoto, Fig. 2, col. 6, lines 11-13). Okamoto's discharge configuration is designed to <u>prevent the plasma from reaching the vicinity of the substrate</u> (see, e.g., Okamoto, Fig. 2, col. 6, lines 13-14). However, Karner teaches that the workpieces are exposed to the plasma, albeit the workpieces are arranged in a low plasma density area. Karner also teaches that a surface F is obtained which has a large radius r and a large length l (col. 3, lines 58-60 and Fig. 1). Thus, Karner teaches a plasma beam that can cover substantially the entire surface of a workpiece.

Based on the foregoing, Applicants respectfully submit that there is no motivation to modify Okamoto with the discharge configuration as taught by Karner because, first, Okamoto specifically teaches directly away from using a discharge configuration with a large radius and a large length. In Okamoto, one dimension of the plasma is substantially smaller than the corresponding dimension of the substrate. See, e.g., Okamoto, Fig. 2 and col. 6, lines 55-64 (which explains that when a substrate is 50 cm on each side, the distance between the electrodes 11 and 12 is only about 8 cm).

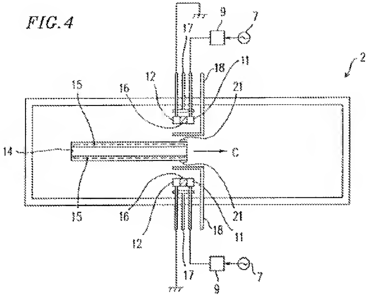
In addition, the proposed modification would change the principle of operation of Okamoto and/or render the modified apparatus inoperative. In Okamoto, the

direct exposure of the entire surface of the substrate to the plasma does not occur until the substrate is transferred to the second vacuum chamber 3, then and only then is a large-area plasma employed (Okamoto, col. 7, lines 22-27). Furthermore, providing Karner's discharge configuration in the first vacuum chamber of Okamoto would not only expose a large area of the substrate to the plasma, but also cause the type of damage that Okamoto's apparatus was designed to prevent (Okamoto, e.g., col. 5, lines 55-59). U.S. Patent 6,015,597 to David also does not provide the missing insight to combining Okamoto and Karner. Accordingly, it is believed that claims 1-8 recite patentable subject matter, and withdrawal of the rejection of claims 1-8 is respectfully requested.

The Office also asserts that Okamoto teaches, "a gas supply section 17, 18 for supplying a silicon containing gas parallel to the discharge axis." See Office Action at page 3, lines 3-4. However, as read by Applicants, Okamoto does not appear to teach this feature. According to Okamoto,

> The gas introduction tube 17 opens in a region between an inner wall of the first vacuum chamber 2 and the opposing electrodes 11 and 12. The gas introduction tube 18 opens in a region between the conveyance path of the substrates 15 and the opposing electrodes 11 and 12... Col. 5, lines 19-24 and Fig. 4 (reproduced below).

FIG. 4



With the openings of the gas introduction tubes 17 and 18 arranged parallel to the discharge axis, it would appear that the gas is discharged perpendicular to the discharge axis. Accordingly, the Office is respectfully requested to cite the passage(s) in Okamoto that disclose the claimed gas supply configuration.

<u>Second Rejection Under 35 U.S.C. § 103</u>

Claims 9-16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over published European patent application number EP 0493609 of Ikegaya in view of Karner and U.S. Patent 5,340,621 to Matsumoto et al ("Matsumoto"). The reasons for the rejection are stated on pages 4-6 of the Office Action. The rejection is respectfully traversed.

The Office Action states:

> Ikegaya teaches a vacuum processing apparatus that includes: a hot plasma discharge configuration 10 located between two planar deposition configuration 7... which extend a selected distance from a plasma discharge configuration; a gas suction configuration 3; and a gas supply section 4 for supplying a gas containing carbon, nitrogen, or

hydrogen gas. (Figure 1)

The Office acknowledges that Ikegaya does not teach:

> [T]he plasma discharge configuration comprises two or more plasma beams with a substantially parallel discharge axes in a low-voltage high-current plasma beam discharge gap between a cathode and anode; the discharge axis (A) is substantially longer than any diameter of said discharge generation areas[;] a gas supply configuration with a gas flow generally parallel to the plasma discharge axis; that the gas flow through the chamber is parallel to the discharge axis; or that the cathode is a cold cathode.

The Office Action relies on Karner to provide the missing feature of Ikegaya, namely, "a plasma processing apparatus that has a… discharge beam 1 axis A in a low-voltage high-current plasma beam discharge gap between a cathode 12 and anode 20… [T]he discharge axis A is substantially longer than any diameter of said discharge generation areas (Entire document, specifically, figures 1, 3, and 3a)." The Office Action also relies on Matsumoto to teach two parallel plasma beam discharge configuration.

The Office Action then states the following as the motivation for replacing the plasma discharge configuration of Ikegaya with the plasma discharge configuration of Karner: "to provide an alternate and equivalent means of forming a plasma in the apparatus of Ikegaya." The Office Action states the following as the motivation for using multiple plasma discharge configuration to form multiple plasma beams in the apparatus of Ikegaya: "to more uniformly distribute plasma over the substrate as taught by Matsumoto."

The Manual of Patent Examining Procedure (MPEP) at § 2143.01(V) states that "[i]f proposed modification would render the prior art invention being modified

unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." Also, "[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." See MPEP at § 2143.01(VI). Moreover, it is "improper to combine references where the references teach away from their combination." See MPEP at § 2145(X)(D)(1).

For the reasons discussed in detail below, Applicants respectfully submit that the Ikegaya, Karner and Matsumoto references teach away from the proposed modification or combination. The Office's proposed modification also renders inoperative and/or changes the principle of operation of the processing apparatus described in Ikegaya.

Ikegaya discloses a compact plasma processing apparatus comprising a plane of thermoelectron radiation material 10 formed of a plurality of wire rods (Ikegaya, e.g., col. 3, lines 14-23 and col. 17, lines 33-36). The substrates 7 are spaced at most 40 mm from either side of the thermoelectron radiation material 10 (Ikegaya, e.g., col. 3, lines 43-46, col. 4, lines 32-35 and col. 6, lines 19-21), "since if larger than 40 mm, the diamond growth rate becomes smaller than 0.5 μm/hr and no practical diamond growth rate can be obtained" (Ikegaya, col. 12, lines 1-8). This also means that the discharge axis, which extends between the thermoelectron radiation material and the substrate (Ikegaya, e.g., col. 10, lines 50-56), is <u>substantially shorter than the cross sectional width</u> of the plasma.

In addition, the claims require the deposition configuration to be positioned along a surface which <u>extends at selected distances from the discharge axes (A) and along a substantial section of the discharge axes</u>, which means that the discharge axes does not intersect the deposition configuration. In sharp contrast, Ikegaya

teaches that the discharge axis extends between an electroconductive buffer material for supporting the substrate (which is connected to the anode) and the thermoelectron radiation material (which is connected to the cathode)(Ikegaya, e.g., col. 10, lines 50-56). As such, the discharge axis of the plasma extends between the substrate and the thermoelectron radiation material, or intersects the substrate.

Furthermore, a uniform plasma 18 is formed between the thermoelectron radiation material 10 and the substrate, with the thermoelectron radiation material serving as the cathode and an electroconductive buffer material 6 or a substrate cooling plate 5 serving as the anode (Ikegaya, e.g., col. 5, lines 50-57, col. 15, lines 19-23 and Fig. 5). Fig. 5 is reproduced below.

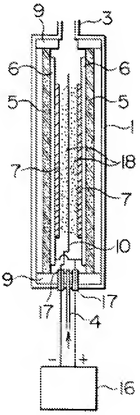


Fig. 5 of Ikegaya

Since the processing apparatus of Ikegaya is capable of generating a uniform

plasma, there does not appear to be any motivation, absent impermissible hindsight, for reconfiguring the apparatus to employ a discharge configuration with a discharge axis that is substantially longer than a cross section of the discharge generation area, as taught by Karner, especially when the modification might eliminate the compactness of the apparatus, which is in direct contradiction to the teachings of Ikegaya. Even installing only one of Karner's discharge configuration might increase the size of Ikegaya's apparatus because Karner teaches placing workpieces in regions of low plasma density where the plasma density only fluctuates slightly (as opposed to generating a uniform plasma and placing the substrate directly in the plasma). In an example configuration disclosed in Karner, 50 mm from the discharge axis is selected to be a lower limit of the distance between the discharge axis and the workpieces (see Karner, e.g., col. 3, lines 29-33). According to Ikegaya, the substrates 7 are spaced at most 40 mm from either side of the thermoelectron radiation material 10 (Ikegaya, e.g., col. 3, lines 43-46, col. 4, lines 32-35 and col. 6, lines 19-21). Therefore, providing two of Karner's discharge configurations as suggested by the Office might increase the size of Ikegaya's apparatus, possibly by two fold. Even if motivation for combining the cited references exists, it is also unclear how one having ordinary skill in the art would be able construct a plasma processing apparatus with the discharge configuration of Karner while maintaining the compact design expressly envisaged by Ikegaya (see, e.g., Ikegaya, col. 2, lines 12-22, stating that one of features that distinguish Ikegaya's invention from the prior art is the compact size of the apparatus; also see col. 22, lines 5-8).

In addition to maintaining the compact design of Ikegaya's apparatus, the proposed modification would require placing the substrate in a <u>zone</u> where the plasma is uniform or has an acceptable amount of fluctuation (see, e.g., Karner, col. 3, lines 34-39), rather than simply generating a <u>uniform plasma</u> between the electrodes

and placing the substrate between them, as taught by Ikegaya (at col. 15, lines 10-23). This would require a substantial reconstruction and redesign of Ikegaya's discharge configuration and change the basic principle under which Ikegaya's processing apparatus was designed to operate. At the very least, the Ikegaya's plasma processing apparatus would no longer be a heating filament CVD device. Therefore, it is submitted that the teachings of the cited references are not sufficient to render the claimed invention obvious.

U.S. Patent 6,015,597 to David also does not provide the missing insight to combining Ikegaya, Karner and Matsumoto. Accordingly, it is believed that claims 9-16 recite patentable subject matter, and withdrawal of the rejection of claims 9-16 is respectfully requested.

Applicants have endeavored to make the foregoing response sufficiently complete to permit prompt, favorable action on the subject patent application. In the event that the Examiner believes, after consideration of this response, that the prosecution of the subject patent application would be expedited by an interview with an authorized representative of the Applicants; the Examiner is invited to contact the undersigned at (845) 359-7700.

Applicants respectfully submit that by this response, the application has been placed in condition for allowance and such action is respectfully requested.

Respectfully submitted,

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